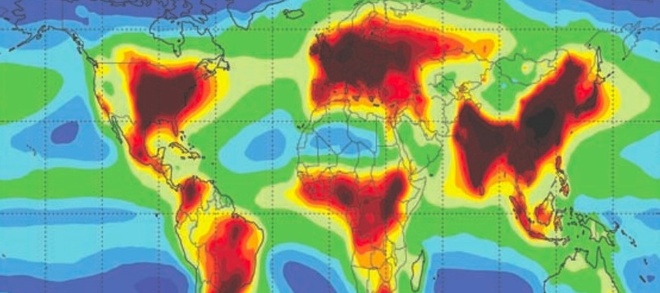
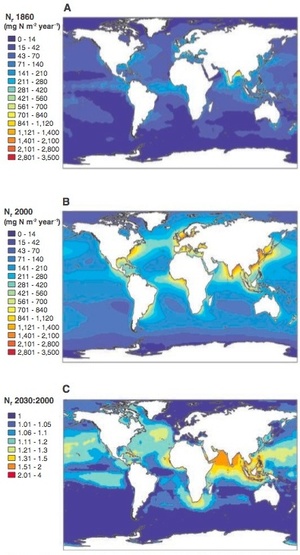
Reactive Nitrogen: The Next Big Pollution Problem

BY [BRANDON KEIM](http://www.wired.com/wiredscience/author/brandon9keim/) on 05.15.08

[](http://www.wired.com/images_blogs/photos/uncategorized/2008/05/15/nitrogendeposition.jpg)

[](http://www.wired.com/wiredscience/wp-content/image.php?u=/images_blogs/photos/uncategorized/2008/05/15/oceannitrogendeposition.jpg)Without nitrogen to fertilize crops, the world couldn’t feed itself. But if humanity doesn’t cut back on the nitrogen it pumps into the environment, we could choke the oceans and ourselves.

That’s the troubling takeaway of two articles published today in *Science*by researchers from the [International Nitrogen Initiative](http://www.initrogen.org/). The first, a review of earlier nitrogen pollution studies, charts the incredible growth of nitrogen in the environment. The second quantifies nitrogen added by human activity to the oceans.

"The natural nitrogen cycle has been very heavily influenced by human activity over the last century perhaps even more so than the carbon cycle," said University of East Anglia biogeochemist [Peter Liss](http://www.uea.ac.uk/env/marinegas/welcome.shtml), a co-author on the second paper.

The problem isn’t strictly nitrogen, which comprises more than three-quarters of the air we breathe, but so-called reactive nitrogen. These are analogous to better-known free oxygen radicals: an altered electron configuration makes them especially unstable, and more likely to wreak environmental havoc.

In 1860, humanity produced 15 metric tons of reactive nitrogen. By 1995, that number stood at 156 tons, and swelled to 185 tons by 2005.

Those numbers are small in comparison to global CO2 emissions — 27 billion tons annually — but the impacts are magnified by what James Galloway, a University of Virginia biogeochemist and co-author of the review, calls the nitrogen cascade.

"My car emitted nitric oxide into the atmosphere this morning. Over time, that moves through the atmosphere, into the soil, into the water, into the coastal systems and back into the atmosphere," he said. "It can contribute to all those impacts."

Some of it comes from industry, but mostly from crop fertilizers. The [Haber-Bosch process](http://en.wikipedia.org/wiki/Haber_process), in which nitrogen, hydrogen and iron sulfate are mixed to make nitrogen fertilizer, is a mainstay of modern agriculture.

"The first and arguably most important impact of reactive nitrogen is that we’re feeding the world’s people. We have to do this to create enough food to feed us," said Galloway.

But downsides are piling up. Reactive nitrogen increases atmospheric ozone levels, causing respiratory diseases and hurting crop yields; produces acid rain; and spurs blooms of oxygen-gobbling oceanic algae, which can hurt fisheries. Nitrogen pollution could eventually render entire stretches of ocean dead, as is now the case in the Gulf of  
Mexico, where fertilizer runoff has created a [5,800 square mile dead zone](http://www.nasa.gov/vision/earth/environment/dead_zone.html)\*. To top it off, oceanic nitrogen is converted to nitrous oxide, a greenhouse gas.

Galloway says that by increasing fuel efficiency, developing-world sewage treatment and the ability of crops and farm animals to absorb nitrogen, reactive nitrogen pollution could be cut by 53 tons per year, or about 28 percent of current totals.

I asked him if this was really progress: Even a drop of one-fourth still leaves global nitrogen pollution at levels nearly ten times greater than those of a century ago.

But Galloway is optimistic. Though scientists have warned for decades that reactive nitrogen could be a problem, policymakers and industry insiders have only recently paid attention. The recommended steps are only the beginning.

"Those are just the things we know we can do today," he said. "I see how far we’ve come in the last ten years, the interactions going on now in individual countries and regions. Using science to help structure policy, we can make great progress."

Critically, said Galloway, the agriculture industry takes the problem seriously.

"Is it us against them, public versus industry? The International  
Nitrogen Initiative has done a lot of work with the fertilizer industry, and they embrace these goals. That’s in part what fuels my optimism."

*\*Dead zones are hypoxic (low-oxygen) areas in the world's oceans and large lakes, caused by "excessive nutrient pollution from human activities coupled with other factors that deplete the oxygen required to support most marine life in bottom and near-bottom water.*